The Confidence Angle in ALOHA

Here is a description of the Confidence angle used in ALOHA.
The relevant computer code from ALOHA is included in the appendix.

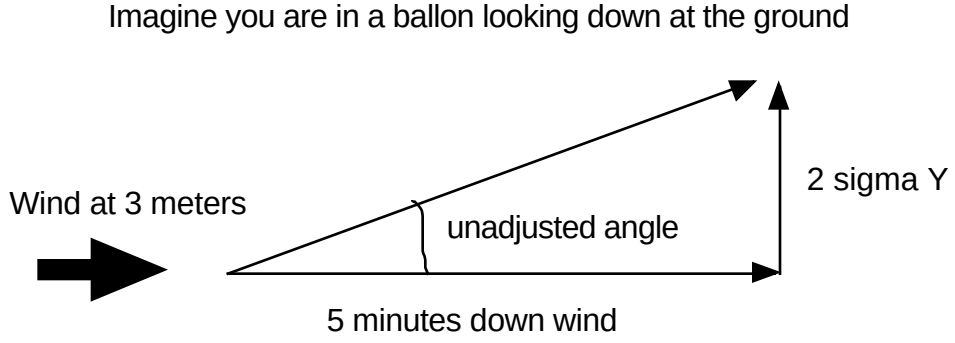
Once the user has entered stability class, wind speed and wind reference height, t confidence angle is found as follows.

(1) ALOHA computes the wind speed ws_3 at a height of 3 meters off of the ground. The stability class, wind speed and wind reference height determine a wind profile. The wind near the ground moves slower than the wind higher up. ALOHA uses it's equations for the profile to find the value at a height of 3 meters.

(2) ALOHA finds the point xRef that is 5 minutes travel time downwind.

distance = ws_3 * (5 minutes)

(3) ALOHA uses 2 sigmaY at xRef to determine a minimum (unadjusted) angle . A spread of 2 standard deviations of a Gaussian Bell shaped curve accounts for 95% of the area under the curve. (Think of the Gaussian curve as representing a history of the wind direction to see a relationship between the 5 minute sigmaY values and plumes staying within these bounds 95% of the time)



(4) ALOHA then adjusts (increases) the angle using the following scheme.

if (ws_3 <=1 m/s) adjustedAngle = PI (180 degrees)

if(1 m/s < ws_3 < 4 m/s) adjustedAngle = multFactor *unadjustedAngle
where multFactor = (4 -1)/ (ws_3- 1)
(Note that there is no adjustment when ws_3 = 4 m/s)
if adjustedAngle > PI, it is set to PI.

if(ws_3 >= 4 m/s) adjustedAngle = unadjustedAngle (no adjustment)

Appendix : Computer code from ALOHA

```
extended GetConfidenceAngle(ALHAGLOBALPTR AGPtr)
{
   /* this function returns the confidence angle in radians */
   SIGMACOEFF   sigmaCoefficients;
   extended   confidenceAngle;
   extended   sigmaY;
   extended   sy1,sy2;
   extended   windSpeed;
   extended   downWindDist;
   extended   multiplicativeFactor;

   OSErr err = noErr;
   extended desiredHt;

   const extended   fiveMinutes = 300;    /*300 seconds*/
   const extended    wRef = 4;/* reference wind speed in meters/sec*/

   /* found by the 2*sigmaY method */
   SetSigmaCoeff(AGPtr,&sigmaCoefficients);
   sy1 =  sigmaCoefficients.sy1;   /* copy for better readability */
   sy2 =  sigmaCoefficients.sy2;
   /* compute the value of sigmaY at the point 5 min downwind */
   // in 5.1, we went 5 min downwind
   // in 5.2 we need to pick a ref ht at which to go 5 min downwind
   //windSpeed =AGPtr->atmdata.WdSpeed.CompValue;
   desiredHt = 3.0;//meters
    err = AlohaWindProfile(desiredHt ,&windSpeed) ;
    downWindDist = windSpeed * fiveMinutes;
   sigmaY = sy1* downWindDist / sqrt(1.0 + sy2 * downWindDist);
   confidenceAngle = atan(2*sigmaY/downWindDist);

   if(windSpeed >= wRef)
   {
      /* we use the computed  confidenceAngle */
   }
   else if(windSpeed <= 1)
   {
      /* the wind speed is less than one meter per second */
      /* we want to draw a complete circle for the confidence lines */
      confidenceAngle = pi();
   }
   else
   {
      /* we multiply the confidence angle by a multiplicative factor */
      multiplicativeFactor = (wRef - 1)/(windSpeed - 1);
      confidenceAngle = confidenceAngle * multiplicativeFactor;
      if(confidenceAngle > pi())
      {
         confidenceAngle = pi();
      }
   }
   return(confidenceAngle);
}
```